PUENTE GUILLERMO ESTEVES
(Bridge No. 86)
(Puente del Agua)
Puerta de Tierra-Miramar Neighborhoods
Spanning the San Antonio Channel at PR-25
(Juan Ponce de Leon Avenue)
San Juan
San Juan County
Puerto Rico

HAER No. PR-36

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
Southeast Region
National Park Service
Department of the Interior
Atlanta, Georgia 30303

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HISTORIC AMERICAN ENGINEERING RECORD

PUENTE GUILLERMO ESTEVES (Bridge No. 86, Puente del Agua) HAER No. PR -36

Location:	PR-25 (Juan Ponce de León Avenue), km. 3.4 spanning the San Antonio Channel Puerta de Tierra/Miramar Neighborboods San Juan San Juan County Puerto Rico U.S.G.S. 7.5 minute San Juan, Puerto Rico quadrangle Universal Transverse Mercator coordinates: 1323 II SE.807730.2043555
Date of Construction:	1925-1927
Engineer:	Eng. Rafael Nones, Designer, with Arch. Rafael Carmoega
Builder:	Eng. Félix Benítez-Rexach
Present Owner:	Puerto Rico Department of Transportation and Public Works
Present Use:	Vehicular traffic (projected for demolition ca.2000)
Significance:	Puente Guillermo Esteves, a five-span concrete and steel girder bridge, is the fourth structure to occupy this site since c.1521. Tbe first was a stone causeway. It was followed by a stone arch bridge whose northern span ended against the gate of a fort which defended its northern end. Several important battles took place around the first two versions of the bridge and the fort. In 1894, the stone bridge was replaced by a four-span iron girder lattice bridge. The present structure, finished in 1927, carries most of the traffic entering historic San Juan islet. It is the the work of Puerto Rican masters: engineers Rafael Nones and Félix Benítez-Rexach and architect Rafael Carmoega. Its northernmost span still rests on the fort's partly visible ruins. The girder structure is concealed by façade arches. The four massive, decorated corner pillars with commemorative plates, together with the decorative cast iron lighting fixtures and the balustrades, convey the monumentality of this very important bridge in terms of historic site associations, access to the historic and waterfront districts, and traffic volume. It is mentioned in Puerto Rico's Historic Bridge Inventory and in the Multiple Property Nomination of Puerto Rico's Bridges and its Associated Historic Context, Land Transportation in Puerto Rico, c.1508-1950.
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A. INTRODUCTION

Puente Guillermo Esteves (HAER No. PR-36), also known as Puente del Agua and Bridge No. 86, carries Route PR-25 (Juan Ponce de León Avenue, a widened part of Puerto Rico's 1886 Carretera Central) over the San Antonio Channel. This channel, which connects San Juan Bay to the west with the Condado Lagoon to the east, separates the islet of San Juan, site of this capital's historic city center, from Puerto Rico's main island. San Juan, the capital of Puerto Rico, is located on the island's north coast. The highway carried by this bridge is the main artery carrying inbound traffic north to the islet of San Juan from its suburbs and the rest of Puerto Rico. This structure belongs to the Puerto Rico Department of Transportation and Public Works.

The Location Plan (page 11) shows the whereabouts of Puente Guillermo Esteves. It is located at kilometer 3.4, between the Puerta de Tierra (north) and Miramar (south) neighborhoods of the municipality of San Juan. Just west of Puente Guillermo Esteves lies the abandoned railroad bridge Puente Ferroviario San Antonio (HAER No. PR- 37), while Puente San Antonio (HAER No. PR-35) is just beyond. The first is one of Puerto Rico's very few remaining railroad bridges; it is now used for pedestrian and recreational purposes. The second was built in 1924-25 for a highway connecting the San Juan waterfront and Miramar, parallel to the Carretera Central.

Puente Guillermo Esteves, a concrete and steel girder bridge finished in 1927, is the fourth structure to span the San Antonio Channel at this site since c.1521. The earlier versions ended against the gate of a fort which guarded its northern end. The fort and the earlier versions of the bridge were attacked by foreign invaders between the 16th and the 18th Centuries.

This bridge is listed in the Puerto Rico Historic Bridge Inventory, which evaluated and selected highway and railroad bridges built on or before 1945. It is mentioned in the Multiple Property Nomination of Puerto Rico's Bridges and its Associated Historic Context, Land Transportation in Puerto Rico, c.1508-1950, as a monumental, non-standard girder bridge occupying a site of extraordinary historic importance. Although its steel and concrete structure is not considered significant in engineering terms, there are elements which provide great significance: length; decorative elements; exemplification of the work of masters; the associated battles; the fort's ruins; the very important route that it serves; and its scenic and historic surroundings.

Although some emergency repair work is currently taking place, this bridge is projected for replacement due to the extreme corrosion of its steel elements and the deterioration of its concrete parts. As part of the corresponding bridge replacement project, this bridge has been documented and photographed according to archival standards at HABS/HAER's Level 2, as agreed in a Memorandum of Agreement.

B. DESCRIPTION AND CONDITION OF THE BRIDGE

Puente Guillermo Esteves is a five-span concrete and steel girder bridge (see photo 1). It is 107.4 meters long and 23.05 meters wide, carrying four lanes of traffic (see photo 5). The actual roadway width is 17.52 meters. Maximum clearance of the arch apex over the water level is 2.96 meters. Maximum clearance over high tide is 1.74 meters. Its northernmost span rests on the ruins of Fort San Antonio, still partly visible east of the abutment (see photo 7). This span is 8.8 meters long, while all the others clear 15.9 meters each (see photo 6). Its piers correspond to and include the foundations of the narrower iron lattice beam structure which preceded it at this site. As can be perceived from contemporary photos taken during the construction of the bridge, the western part of its width was built first, while the eastern part replaced the previous narrow structure, using at least parts of its piers and piles. This methodology did away with the need of a provisional structure during construction.

The commonplace structural system is concealed by decorative arches, reflecting the facades of its contemporary parallel neighbors (see photo 2). Four massive, decorated corner pillars (see photo 9) and the long balustrades (see photo 10) between them define a short causeway approach which lies south of the structure's southern abutment as part of the bridge. The corner pillars are 20 feet high and 5 feet square. Each of the two northern pillars feature marble plaques, one with information on the persons responsible for its placement, design and construction, and the other on the battle with British invaders held here in 1598 (see photos 11 and 12). The bridge is lined by attractive concrete balustrades and cast iron lampposts (see photo 13).

The structure consists of mainly of built-up steel plate girders encased in concrete (see photos 14 and 15), except for the shorter northernmost span which uses rolled steel I-beams. The latter are 24" deep and weight 80 pounds per lineal foot. They are set 1.5 meters apart, center to center. The typical spans of 15.90 clear meters use girders formed by horizontal angles of 6" x 4" x 3/4"; web of 26" x 1/2"; horizontal plaques of 14" x 1", and reinforcement vertical angles of 3 1/2" x 2" x 3/8". Their load was estimated at around 120,000 pounds per girder, including its own weight, the concrete encasement, the slab, and the design live load. The load on their piers and abutments was estimated at around 60,000 pounds, and the pressure on the concrete 180 pounds per square inch. The design estimated weights of 2,900,000 pounds over the bases of the piles are shared by 58 piles (probably including the wooden piles of the existing foundation of the previous bridge), at a ratio of 25 tons per pile.[1]

The girders and their concrete encasements, the piers, and the façade arches are heavily deteriorated. Many sections of the balustrade have been impacted and rebuilt. The bridge's structure is now being reinforced because its load capacity has fallen below standard.

C. HISTORICAL BACKGROUND [2]

Although Columbus landed in Puerto Rico in 1493, Spanish settlement of the island did not begin until early in the next century under Juan Ponce de León. For defensive reasons, Ponce de León established the capital, Caparra, about two kilometers south of San Juan Bay, in a region surrounded by wetlands. San Juan's bay is formed by the dry, rocky Isle of San Juan in the north and the hills and mangroves of the north coast of the main island. The narrowest body of water between the Isle and the main island is the San Antonio Channel.

Inaccessibility and mosquitoes forced the settlers to move the capital city from Caparra to the western tip of the Islet of San Juan. This elongated sandstone formation forms the bay and protects it from the Atlantic Ocean. It is separated from the main island by the San Antonio Channel, which may have been approximately 200 meters across at that time. The island's first road linked Caparra with the capital's new location on the Isle. Built between 1520 and 1521, it included the first two bridges of any significance built on the island. One crossed the San Antonio Channel and the other one the Martín Peña Channel. This road, which was paved around 1850 between San Juan and the Martín Peña bridge, remained the only land link between San Juan and its hinterland in the main island until the 1880s.

THE FIRST BRIDGE ACROSS THE SAN ANTONIO CHANNEL

The first bridge over the San Antonio Channel, partly corresponding to the site of today's Puente Guillermo Esteves, was, for most of its length, a two-part stone causeway linking the low, southeastern end of the Isle with the firm ground adjacent to the hills of Miramar in the main island. It was erected by enslaved Indians working under Jerónimo priests between 1520 and

1 Bridge Records, Puerto Rico Highway and Transportation Authority.

2 Most of this section is based on Pumarada, *Los puentes...*

1521. the main island. It was erected by enslaved Indians working under Jerónimo priests between 1520 and 1521.

The northern section of causeway corresponded to the straight, masonry-protected western edge of the entrance to the Condado Lagoon. This entrance was known in those days as "Caleta del Boquerón". Today, this edge extends northward from the intersection of the Ponce de León and Ashford Avenues, contiguous to the northern abutment of the existing structure. The southern part is said to have deviated about 20 degrees from the present alignment of the Guillermo Esteves Bridge.[3] Between the two sections of causeway was a small open space for the passage of water and boats. This space, spanned by a wooden bridge, may have corresponded approximately to the northernmost span of the modern day structure.

In 1558 an aqueduct was built over the causeway to bring water from a spring, Fuente de Aguilar, in the main island. The water flowed into a deposit located north of the bridge's abutment in the Isle of San Juan, several meters. Since then, the structure has been unofficially known as "Puente del Agua" (the water's bridge).

In 1568 the wooden bridge between the two causeway sections was reconstructed. At the southern end of the northern causeway, next to the wooden structure, a large gate had been built with an adjoining guard house. A garrison, provided with pieces of artillery, was permanently stationed there to defend the bridge and the eastern end of the Isle. As early as 1586, a triangular fort and a pair of 20 foot long walls defended the gate.[4] As a result, the bridge had also become known by the name "Puente de los Soldados" (the soldier's bridge). The gate into the islet was closed at night.

George Clifford, Earl of Cumberland, found his efforts to conquer Puerto Rico in 1598 foiled by these forces, then commanded by militia officer Bernabé de Serralta. Serralta and his men resisted a force of about one thousand enemies, wounding Clifford as he attempted to cross over the causeway. However, the causeway and its bridge were almost totally obliterated by the attackers' artillery.

OTHER EARLY VERSIONS

Upon its reconstruction in 1608-1613, a stone arch bridge was built in place of the southern part of the causeway. The stone bridge kept a small span made of wood to permit disassembly for defensive reasons. The northern part of the causeway was repaired and on its widened southern end a larger fortification was erected in stone. It was called "Fortín San Antonio". The fort and its large gate were integrated to the bridge abutment in such a way that the bridge ended right against the fort's door. People, animals and vehicles entering the Isle had to cross the fort's solid, heavy, two-meter wide gate and walk through the middle of the fort, defended by soldiers and artillery.

These must have been the structures represented in the drawings of San Juan made by the Dutch attackers of 1625. Hendricks, the Dutch leader, avoided the fortified bridge and risked entering the bay with his fleet right through its mouth, defended by the much larger fort called San

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3 Vega, "Evaluación..." The earliest graphic representations that show the bridge in its context seem to be drawings made by Dutch invaders c.1625. These show a steeper angle between both spans of causeway in comparison to posterior plans which do correspond with today's characteristics. These Dutch drawings, however, give a poor overall representation of that part of the islet and the lagoon. On the other hand, the presence of a steeper angle does not make military sense, nor seems compatible with the shape of the lagoon. We can infer then that these are not trustworthy drawings.

4 Vega, "Evaluación..."

Felipe del Morro. However, Morro's artillery was faulty and the Dutch were able to burn and loot San Juan.

In 1660 the bridge was again repaired and the wooden section rebuilt in stone. The bridge was then 4.8 meters wide and consisted of three segmented arches, each spanning approximately five meters, plus an approach causeway.

In 1776, concurrently with the enhancement of the defensive works protecting the city and the Isle, the stone bridge was rebuilt over pile foundations and the fort enlarged.[5] This work was conducted by the renowned military engineer Thomas O'Daly.

In 1797 a British fleet of sixty ships commanded by Ralph Abercromby disembarked between six and seven thousand men about two miles east of the bridge's southem end. The main objective of these forces was the Fortín San Antonio and its bridge. They placed artillery at two points, one in Condado, across the forts of San Jerónimo and Escambrón, and the other at Monte Olimpo in Miramar, above the San Antonio bridge. In April 24th, they opened fire against the three forts. The Fortín San Antonio was practically destroyed. Even still, the British could not cross the bridge thanks to the fierce defense of Captain Ignacio Mascaró and his men, stationed behind barriers made of sandbags, arranged among the fort's ruins. Having been defeated in other attacks, the British left Puerto Rico the 3rd of May.[6]

THE BRIDGE BECOMES PART OF THE CARRETERA CENTRAL

Except in military terms, the role of Puerto Rico in the Spanish New World Empire was minor during its first three hundred years of Spanish rule. The port of San Juan remained a critical defensive link for the Spanish Caribbean and a key port in the route of the treasure fleets. Spain had fortified the port and the access routes to the city since the 16th Century, and maintained a detachment of soldiers which defended them successfully in several occasions. By the mid-seventeenth century, while San Juan became a walled city in a rocky islet guarded by a fortified bridge, Puerto Rico's economic activity was limited to a few cattle ranches and a handful of small cane sugar and tobacco plantations, plus disperse logging and small-scale ginger and hog production for smuggling.

However, in the second half of the eighteenth century there came about structural changes occurring concurrently with economic and population growth which required more and better transportation facilities. In the 1820s the colonial government improved San Juan's communications with its hinterland. Before the 1840s there had been practically no paved highways in Puerto Rico, but in 1846, as the bridge over the Martín Peña Channel was being totally reconstructed, the construction of the 41 kilometers of macadam paved highway between San Juan and Caguas was begun. The San Juan-Río Piedras stretch, which included the San Antonio Channel Bridge, was finished by 1853.

A highway plan was developed in the second half of the century; it included a first order highway from San Juan to Ponce passing through Caguas, Cayey, Aibonito, Coamo and Juana Díaz. This route across the humid, rugged Central Mountain Range became the government's main priority because the coasts were being served by scheduled coastal shipping. The existing highway between San Juan and Rio Piedras, which contained the San Antonio and Martín Peña bridges, became the first official stretch of this route, which had been named the Carretera Central.

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5 Vega, "Evaluación..."

6 This action is represented in a contemporary painting by José Campeche that includes Fort San Antonio. The fort depicted is very similar to the later reconstruction, of which photos are kept from the end of the Nineteenth Century.

The highway was completed in 1886. With 134 kilometers, 33 roadmen's houses, and 13 permanent bridges, it had become a monument to Spanish and Puerto Rican engineering.

GROWTH AND DEVELOPMENT REQUIRE NEW STRUCTURES

The year 1880 saw the establishment of a small steam-powered passenger train between San Juan and Río Piedras. This commuter railroad, which consisted of a small steam engine pulling two passenger cars over one-meter gage rail, crossed the San Antonio Channel over the Puente del Agua highway bridge. About six years later, the railroad company built its own steel trestle bridge west of the highway bridge. This railroad was converted into an electric trolley line about 1904.

After major repair work performed in 1827, Puente del Agua had essentially remained unchanged until in 1894. On that date the centuries old and often reconstructed stone structure was replaced by a metal structure designed by engineer Joaquín Gisbert. The new bridge had vaulted masonry access spans and four lateral open-web lattice beam wrought iron spans resting on stone piers over wood piles. The four spans added up to a total length of 55.5 meters. The northernmost span was designed for quick disassembly to allow better defense of the capital and its bay in case of enemy attack. These metal spans were seven meters wide; imported in pieces from France. Three of these spans measured 15.8 meters each; the fourth, disassemblable one, which was supported at its north end directly on the fort's foundations, was 8 meters long. The stone piers were two meters thick in the upper part and faced with ashlar. The lower part of its lattice girders was only 1.40 meters above high tide and two meters above low tide. When increasing traffic required a wider roadway, the sidewalks were eliminated and pedestrian catwalks erected on both sides of the bridge.[7]

A franchise had been granted in 1888 to the French-owned Compañía Ferrocarrilera de Puerto Rico (C.F.P.R.) to build and operate a railroad which would encircle the island. However, C.F.P.R. was short of capital and it suspended construction work in 1893 with only three unconnected rail stretches in operation. C.F.P.R. erected a French-fabricated steel through-truss bridge over the San Antonio Channel which was put into use in 1890 and officially inaugurated in 1891 as part of the San Juan - Martín Peña line. This line and other stretches which were in service in 1893, which totalled 270 kms., remained the only existing ones until 1902. The American Railroad of Puerto Rico (A.R.R.), an American firm, bought the franchise on that date and completed the San Juan-Ponce route in 1906.

By 1898, year of the American invasion of Puerto Rico, the islet of San Juan was joined to Miramar in the main island by three metal bridges crossing the San Antonio channel. These were: the Puente del Agua, the commuter train bridge, and the C.F.P.R. railroad bridge.

About 1896, the Canadian-owned Porto Rico Railway, Ice and Power Co. had bought the commuter train, and by 1904 it had substituted the small steam system by electric trolley cars. In August, 1912 it obtained permission to widen its bridge over the San Antonio Channel to serve a double rail for its trolley cars. This bridge kept its steel trestle structure, and came to be considered an eye-sore by many, especially after the adjacent bridges were replaced by white, ornamented, gently-arched concrete structures. It was destroyed shortly after the trolley folded in the early 1950s. The bases of its steel trestles remain underwater.

Fort San Antonio's superstructure, including its gate, were done away with in 1897, one year after the demolition of San Juan's city walls and gates which restricted the land-side access into the city. Only the lower parts of the fort's walls were left on both sides of the bridge's northern end.

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7 de Hostos, 1979.

A NEW COLONIAL GOVERNMENT

In May 12, 1898, at around 5:20 in the morning, artillery fire shook Puerto Rico's capital city. Various American ships commanded by Admiral Sampson fired for nearly three hours at the city, its fortifications, and the bay. In May 15th, a rumor spread that the bombardment would be repeated, and fear struck the inhabitants. A long row of carts, coaches, and people on foot marched across Puente del Agua to Santurce and Río Piedras, while others took the ferryboat across the bay.

In August 2nd, with the U.S. Navy blocking the entrance to the bay, and American forces invading the southern part of the island, the authorities proceeded to destroy spans of the highway bridges over the San Antonio and Martín Peña channels. However, pieces of timber were placed between the piers to allow passage. In August 13th, with most of the southern half of the island occupied by American troops, San Juan learned that the peace treaty had been signed and that Spain had ceded its sovereignty over Puerto Rico to the invaders.

THE SAN ANTONIO CHANNEL

The San Antonio Channel's coastline was altered several times since the 1500s to facilitate the construction of these structures and their approaches. Perhaps 200 meters wide originally, the channel's width was first altered by the construction of the 16th Century causeway approaches. Between the 1520s and the 1880s, the shallow water west of the northern end of this causeway, between the San Juan islet and the bridged water passage between its two parts, was covered by mangrove. The garrison of Fort San Antonio kept a small pier between the mangrove and the western side of the fort. The channel's southern coast, next to the deeper, moving water, had been slightly altered by the causeway and its approach. In subsequent years, additional fill had to added next to these features to protect them from erosion and wave action.

Between c.1886 and 1924, in order to facilitate the construction of the next three bridges, the western parts of both channels' coastlines were brought inward with fill dredged from the bottoms of the channel and of adjacent San Juan Bay. They were made parallel, coinciding approximately with the position of the southern end of the fort on the north and with the approach of Puente del Agua on the south.

THE CONSTRUCTION OF PUENTE GUILLERMO ESTEVES

Highway construction in Puerto Rico had a peak in the 1920s. Among the reasons were the rapid expansion of the U.S. automobile industry and its effect in Puerto Rico, an economic expansion in Puerto Rico due to rising sugar cane and coffee prices, and the introduction of new machinery and techniques for highway building and their cost-reducing effects. The highway bridges built in that period included a new parallel bridge across the channel, finished in 1925, parallel to Gisbert's 1894 structure, and the replacement of the latter in 1927 with the present version, Puente Guillermo Esteves.

The replacement of the Puente del Agua highway bridge had been authorized since 1923 by the Puerto Rican legislature as part of the plans to widen to twenty meters Ponce de León Avenue within San Juan and Santurce. In August, 1925, as soon as the new parallel bridge had been opened, construction of the present Puente Guillermo Esteves was begun. To be able to build a 20-meter wide bridge, most of the remaining superstructure of Fort San Antonio flanking the northern end of the 1894 bridge was destroyed. Only the foundation walls were left, with some ramparts east of the new bridge. First the eastern half of the concrete bridge was built on new extensions to the piers of the existing bridge. Once this structure was carrying traffic, the 1894 bridge was dismantled and the western half of the new bridge was erected, using the old structure's piers and wood piles. Construction finished in 1927 at a total cost of $201,014. Its original pavement consisted of asphalt tiles.

Upon its opening, this new, monumental bridge was named after the Commissioner of Public Works, Guillermo Esteves, although it is still occasionally referred to as Puente del Agua. The bridge still deserves the name Puente del Agua, however: there are water and gas pipes and other utilities hanging between its girders.

DESIGNERS AND BUILDER

Both San Antonio Channel highway bridges were designed by Eng. Rafael Nones, the most prolific and successful bridge designer in Puerto Rico between 1910 and 1930. They were designed after the first phase of the concrete reconstruction of the neighboring railroad bridge, and they matched its style of concrete pier and arch façade. The two structures were conceived as monumental bridges, and provided with ornamentation such as balustrades, cast iron lamp posts and corner pieces or pilasters. One of Puerto Rico's foremost architects of the era, Rafael Carmoega, assisted Nones in the design of the Esteves bridge.

The Esteves Bridge was constructed by Puerto Rico's most successful bridge builder, internationally known builder Eng. Félix Benítez-Rexach. Nones and Benítez-Rexach are identified in the historic context of the Multiple Property Nomination of Historic Puerto Rican Bridges as master builders.

BRIDGE SURROUNDINGS

This bridge is located within an urban-coastal landscape of great beauty, underlined by the Condado Lagoon. The area is surrounded by sites of great interest in Puerto Rico's history, including the remains of Fortín San Antonio. Two Benítez-Rexach properties, the Normandie Hotel, recently restored to its old splendor, and the site of the Escambrón Beach Club are close by. Fort San Jerónimo and the old Muñoz Park Powderhouse are also nearby. A dog-shaped rock featured in a well known legend is visible at the mouth of the lagoon, between Fort San Jerónimo and Condado. The Isla Grande Airport, Puerto Rico's first international airport, nowadays used for small airplanes only, is about 100 meters away.

In 1933, the western access ramp to the Esteves bridge was repaired and widened at a cost of $4,746.25. Through an agreement between the Federal authorities and a special proclamation of the President of the United States, the ownership of the access curve and the area it occupied, was transferred to the government of Puerto Rico. As part of this project, the area north of the bridges between the access curves was landscaped and two fountains were built by the Muñoz Rivera Park Commission by 1941-42. This landscaping project was called Jardines del Puente Esteves.

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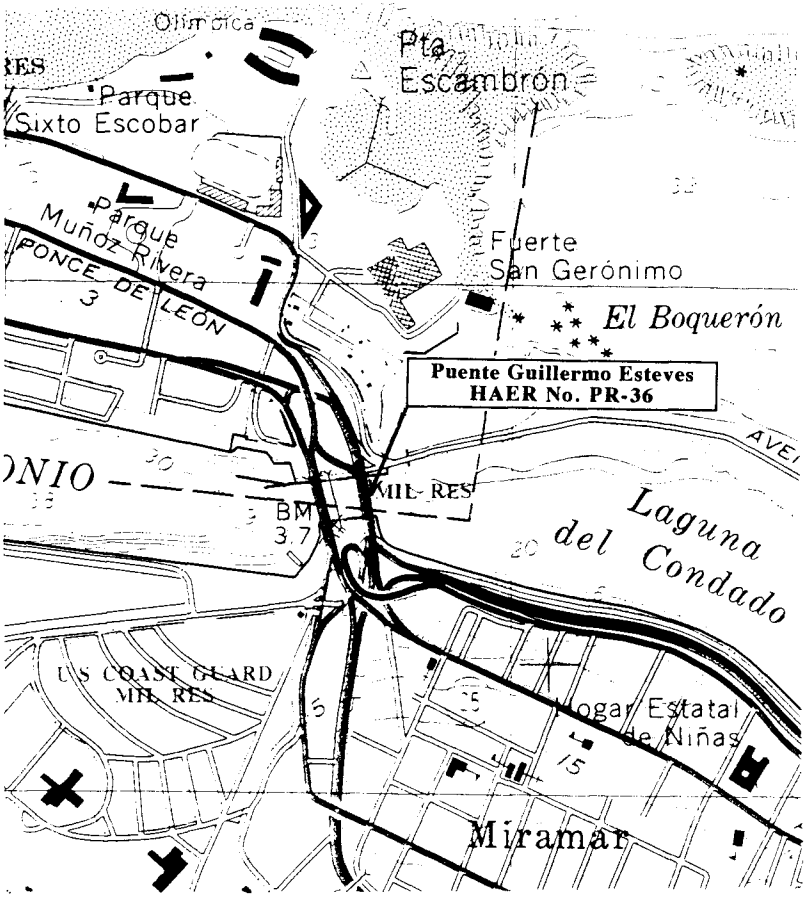

LOCATION PLAN

NOT TO SCALE